

**CLAIMS**

What is claimed is:

- 1    1.    A magnetic head having a pinned area, a free area, and a nanoconstricted area  
2        encompassing portions of the pinned and free areas, the head comprising:  
3        a first layer of magnetic material extending along the pinned and free areas;  
4        an AP coupling layer extending along the pinned area; and  
5        a third layer of magnetic material, an active portion of the third layer extending  
6                along the pinned area but not along the free area;  
7        wherein the first and third layers have magnetic moments that are self-pinned  
8                antiparallel to each other in the pinned area and a portion of the  
9                nanoconstricted area encompassing the pinned area.
  
- 1    2.    A head as recited in claim 1, wherein a height of the nanoconstricted area is less  
2        than about 100 nanometers.
  
- 1    3.    A head as recited in claim 1, wherein a height of the nanoconstricted area is less  
2        than about 50 nanometers.
  
- 1    4.    A head as recited in claim 1, wherein a height of the nanoconstricted area is about  
2        10 to 30 nanometers.

- 1 5. A head as recited in claim 1, wherein the third layer has been removed from the  
2 free area by at least one of etching and milling.
- 1 6. A head as recited in claim 1, wherein a portion of the third layer in the free area  
2 has been rendered nonmagnetic.
- 1 7. A head as recited in claim 6, wherein the portion of the third layer in the free area  
2 has been rendered nonmagnetic by oxidation.
- 1 8. A head as recited in claim 1, further comprising a hard bias layer positioned  
2 outside the free area for stabilizing the first layer in the free area.
- 1 9. A head as recited in claim 1, wherein the first layer includes NiFe.
- 1 10. A head as recited in claim 1, wherein the third layer includes CoFe.
- 1 11. A head as recited in claim 1, wherein the AP coupling layer includes Ru.
- 1 12. A magnetic head having a pinned area, a free area, and a nanoconstricted area  
2 encompassing a portion of the free area and a greater portion of the pinned area,  
3 the head comprising:  
4 a first layer of magnetic material extending along the pinned and free areas;  
5 an AP coupling layer extending along the pinned area; and

6 a third layer of magnetic material extending along the pinned area but not into the  
7 free area;  
8 wherein the first and third layers have magnetic moments that are self-pinned  
9 antiparallel to each other in the pinned area and the nanoconstricted area.

1 13. A head as recited in claim 12, wherein a height of the nanoconstricted area is less  
2 than about 100 nanometers.

1 14. A head as recited in claim 12, wherein a height of the nanoconstricted area is less  
2 than about 50 nanometers.

1 15. A head as recited in claim 12, wherein a height of the nanoconstricted area is  
2 about 10 to 30 nanometers.

1 16. A head as recited in claim 12, wherein the third layer has been removed from the  
2 free area by at least one of etching and milling.

1 17. A head as recited in claim 12, wherein a portion of the third layer in the free area  
2 has been rendered nonmagnetic.

1 18. A head as recited in claim 17, wherein the portion of the third layer in the free  
2 area has been rendered nonmagnetic by oxidation.

- 1     19.     A head as recited in claim 12, wherein the first layer includes NiFe.
- 1     20.     A head as recited in claim 12, wherein the third layer includes CoFe.
- 1     21.     A head as recited in claim 12, wherein the AP coupling layer includes Ru.
- 1     22.     A magnetic head having a pinned area, a free area, and a nanoconstricted area  
2            encompassing a portion of the pinned area and a greater portion of the free area,  
3            the head comprising:  
4            a first layer of magnetic material extending along the pinned and free areas;  
5            an AP coupling layer extending along the pinned area; and  
6            a third layer of magnetic material extending along the pinned area but not into the  
7                        free area;  
8            wherein the first and third layers have magnetic moments that are self-pinned  
9                        antiparallel to each other in the pinned area.
- 1     23.     A head as recited in claim 22, wherein a height of the nanoconstricted area is less  
2            than about 100 nanometers.
- 1     24.     A head as recited in claim 22, wherein a height of the nanoconstricted area is less  
2            than about 50 nanometers.

- 1    25.    A head as recited in claim 22, wherein a height of the nanoconstricted area is  
2            about 10 to 30 nanometers.
- 1    26.    A head as recited in claim 22, wherein the third layer has been removed from the  
2            free area by at least one of etching and milling.
- 1    27.    A head as recited in claim 22, wherein a portion of the third layer in the free area  
2            has been rendered nonmagnetic.
- 1    28.    A head as recited in claim 27, wherein the portion of the third layer in the free  
2            area has been rendered nonmagnetic by oxidation.
- 1    29.    A head as recited in claim 22, wherein the first layer includes NiFe.
- 1    30.    A head as recited in claim 22, wherein the third layer includes CoFe.
- 1    31.    A head as recited in claim 22, wherein the AP coupling layer includes Ru.
- 1    32.    A magnetic storage system, comprising:  
2            magnetic media;  
3            at least one head for reading from and writing to the magnetic media, each head  
4            having:  
5            a sensing element having the structure recited in claim 1;

- 6                   a write element coupled to the sensor;
- 7                   a slider for supporting the head; and
- 8                   a control unit coupled to the head for controlling operation of the head.